IMPACTS OF SIZE, COMPOSITION AND COMPACTNESS OF THE DELAYED ENTRY POOL ON ENLISTMENT CONTRACT PRODUCTION:

Efficient Allocation of Recruiting Expenditures and Optimal DEP Management

A technical Final Report Prepared for the Naval Recruiting Command Under Sponsorship of the Navy's MPT R&D Program and the Army Research Institute

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1.0 BACKGROUND AND THRUSTS OF EFFORT

1.1 The Delayed Entry Program

Each of the Armed Services' Recruiting Commands enables a potential recruit to delay his actual shipping date (called his accession date) for up to a year from the time he signs an obligation (a so-called contract) to enter a given Service. If a recruit chooses to delay his shipping date beyond a month of his time of contract signing, he enters the so-called Delayed Entry Program (DEP); those recruits who do not enter the DEP are called "Direct Shipments." The DEP device is very popular with both recruits and recruiting managers, with over 80% of all DoD accessions utilizing the mechanism.

The size of DEP is thought to have a positive impact on recruiting efforts in that it synergistically complements the expenditures of advertising and of individual recruiter's efforts. Those recruits who have made a decision to enlist in a given Service often encourage their peers to inquire about that Service as a possible option and often become a type of recruiter aide. Indeed the Navy encourages referrals by a recruit in DEP by awarding an advance in his paygrade if the number of referrals (who actually enlist) exceeds 2. More exactly, a recruit who is credited with 3-4 referrals starts as an E-2 (in contrast to an E-1), whereas a recruit credited with at least 5 referrals starts as an E-3. In FY86, about 5600 recruits (7% of the total accessions) with no college credits* started at higher than an E-1.**

In addition, the Navy's PUMP (Production Upgrade Management Program) philosophy, pioneered by RADM Freeman, USN (ret) views DEP size as a resource to be allocated and balanced over the various recruiting areas, much akin to

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*Those with substnatial college credits can start at higher than an E-1.

**The Nuclear program also enables recruits to enger at higher than an E-1 so it is not possible to estimate the referrals from DEP precisely.

recruiters, support dollars, and advertising. The PUMP logic has its impact in the allocation of accession quotas across different regions which often differ from contract quotas.

Another qualitative perception about DEP has to do with what is termed "relief from direct ship pressure", i.e., if a recruiter can meet most of his accession goal for the next month from DEP, then he gains the flexibility to "prospect" in the non-direct ship market; this market, typically of much higher quality individuals, takes more lead time to convince individuals to commit several years of their life to the military. If this DEP positioning, sometimes referred to as "compactness", is not in place to cover the short term needs, the recruiter has but little choice to go after the "direct shippers" who tend to be those without a high school diploma. The Navy has a stated policy for recruiters that a maximum of 100%* of the next month's accession goal should be coming out of DEP. The goals for the 2nd, 3rd and 4th outmonths are respectively 90%, 85%, and 80% for total active duty new contracts. Hence, even if the DEP size is large, if it is not sufficiently positioned so as to mesh with the accession quotas, then recruiting problems can occur.

Finally, a third aspect of DEP has to do with the composition of DEP in terms of quality. Quality of recruits is measured on two dimensions, namely, possession of a high school diploma or not, and mental category. The enclosed Recruit Quality Matrix (Figure 1) shows, e.g., that the A cell contains recruits who have both a high school diploma and who also score above the 50th percentile on the Armed Services Vocational Aptitude Battery. Finally, Table

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*The goal is actually less than 100% since some slots are desired to be left open for prior service enlistments as well as desired flexibility in being able to reduce accessions.

Figure 1: **RECRUIT QUALITY MATRIX**

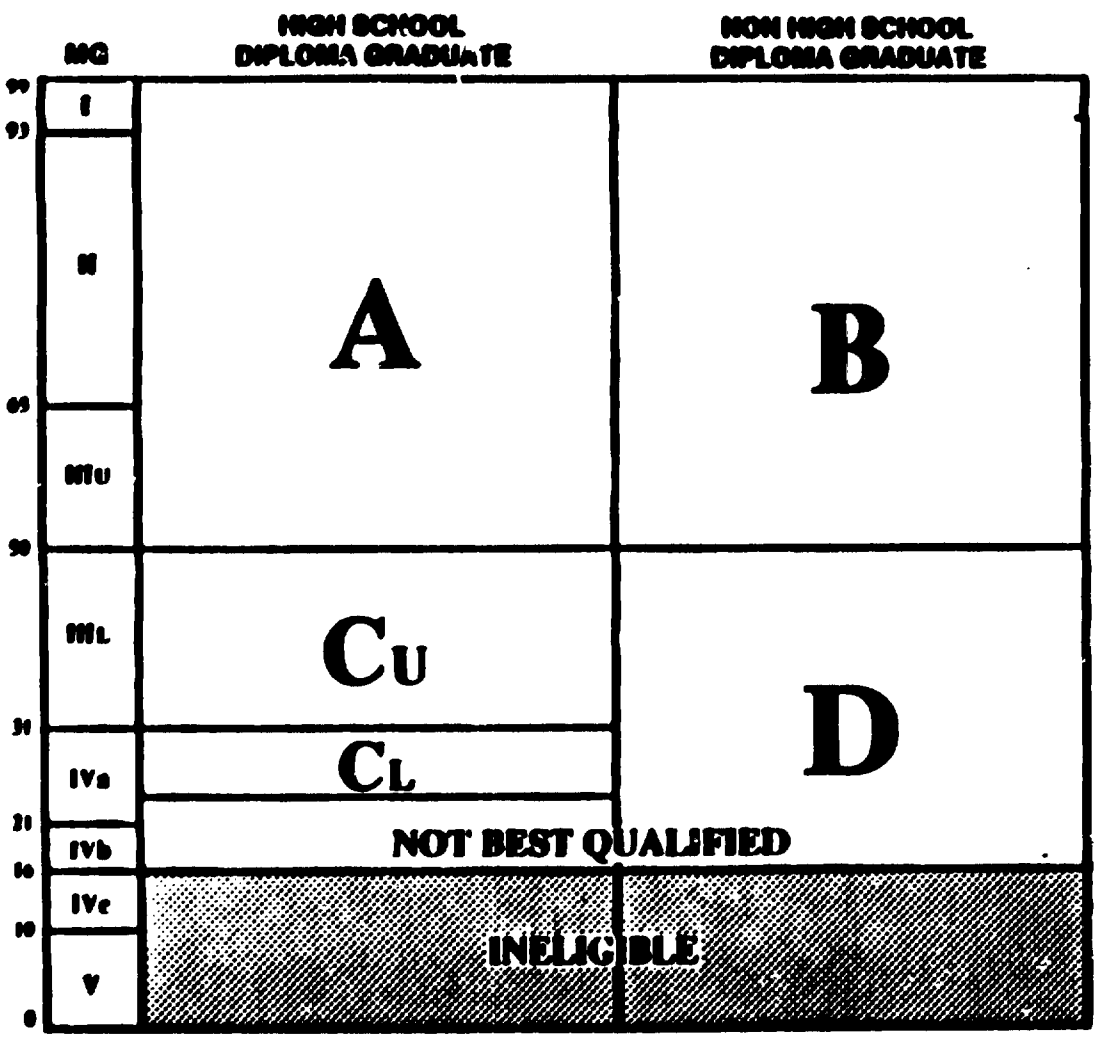


Table 1: General Advantages and Disadvantages of Larger DEP Sizes

	Advantages		Disadvantages
I)	Source of referrals	I)	Liaisons between recruiter and DEPers cut into recruiter's time for other activities
II)	Less attrition in first term since more realistic expectations about military life	II)	Recruiter may feel he can "live" off DEP pool (especially at end of his term)
III)	Smoothing of recruiting efforts	III)	Not able to adjust quickly to lower accession goals
IV)	Long range planning tool as a hedge against economy upturns or other events adverse to recruiting	IV)	May not have sufficient slots for direct ships and prior service enlistments
V)	No longer any longevity impacts on base pay associated with time spent in DEP	V)	Equity problems related to differences in DEP size per recruiter (especially for new recruiters)
VI)	Relief from direct shipment pressure (related to this month's accession requirements); enables recruiters to do prospecting for better recruits in latter months	VI)	Long time spent in DEP is associated with more attrition in DEP

l summarizes the advantages and disadvantages of larger DEP sizes. Observe that the size of DEP can possibly be too large since recruiters must spend liaison time with DEPers that can cut into their other activities. Indeed, Air Force recruiters at one time had an average of 45 DEPers* per recruiter. This was deemed too large to be manageable so the DEP position was allowed to fall. For some years, Services have tried to have about one-third of their next year's accession goals in DEP at the beginning of the fiscal year. One of the key questions in which we wish to gain new insights is "Is this too much or too little?".

1.2 Brief Overview of National DEP Statistics Over Period FY84-FY86

The next section provides some highlights of variations in DEP at the national Level which clearly show that management of DEP over the years has varied widely. Many more details on this topic appear in Sections 2.2 and 2.3.

i) Male, NPS, active duty DEP for the Navy averaged about 30K recruits (varying from 39.2K in February 1984 to 23.4K in November 1985).

ii) From FY84 to FY86 the average DEP size (throughout fiscal year) was down nearly 9K recruits.

iii) Average male DEP size per recruiter was down from 12.21 in FY84 to 8.1 in FY86 (about a 34% drop). See Figure 2 for the monthly variation.

iv) On average, 88% of male, NPS, active duty DEP is composed of 2 cells, A and C_u (see Figure 1); hence most of it consists of those with a high school diploma or seniors expected to receive one. See Figures

*The average for the Navy has varied between about 8-12 over the period FY84-FY86.

Figure 2: SIZE OF DEP OF TYPE A PER RECRUITER BY MONTH (FROM FY84-FY86)

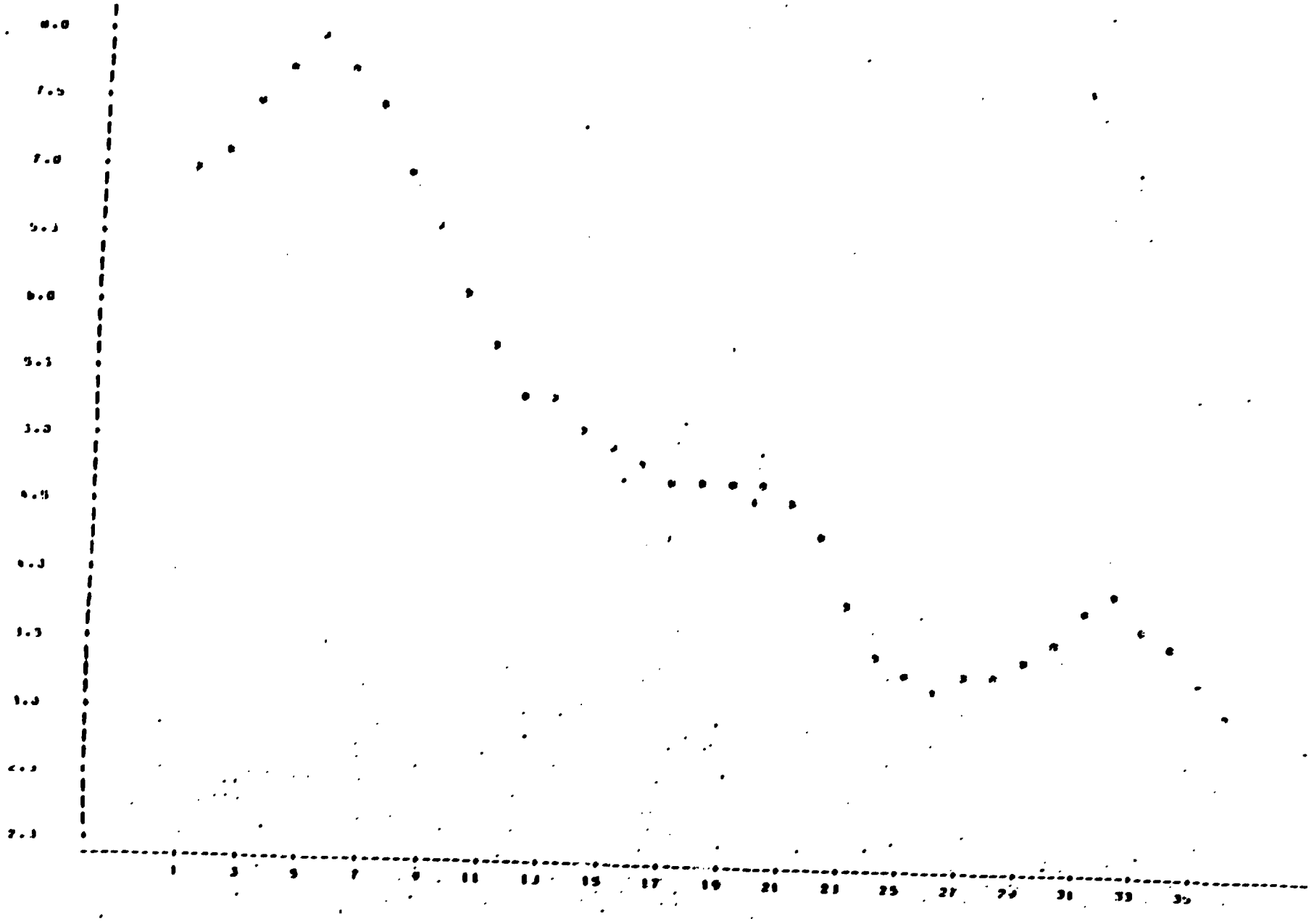


Figure 3: Variation in A cell contract production

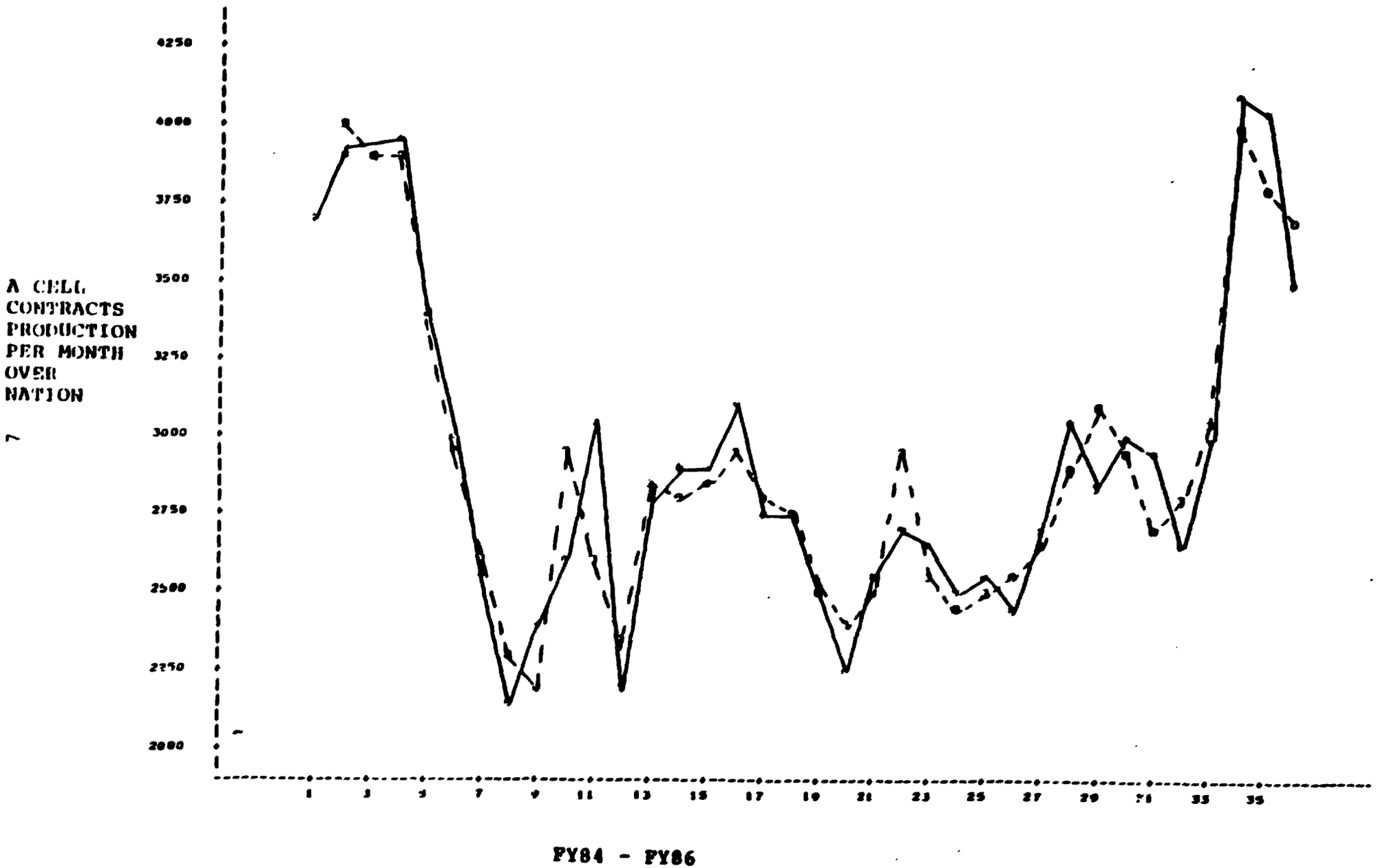
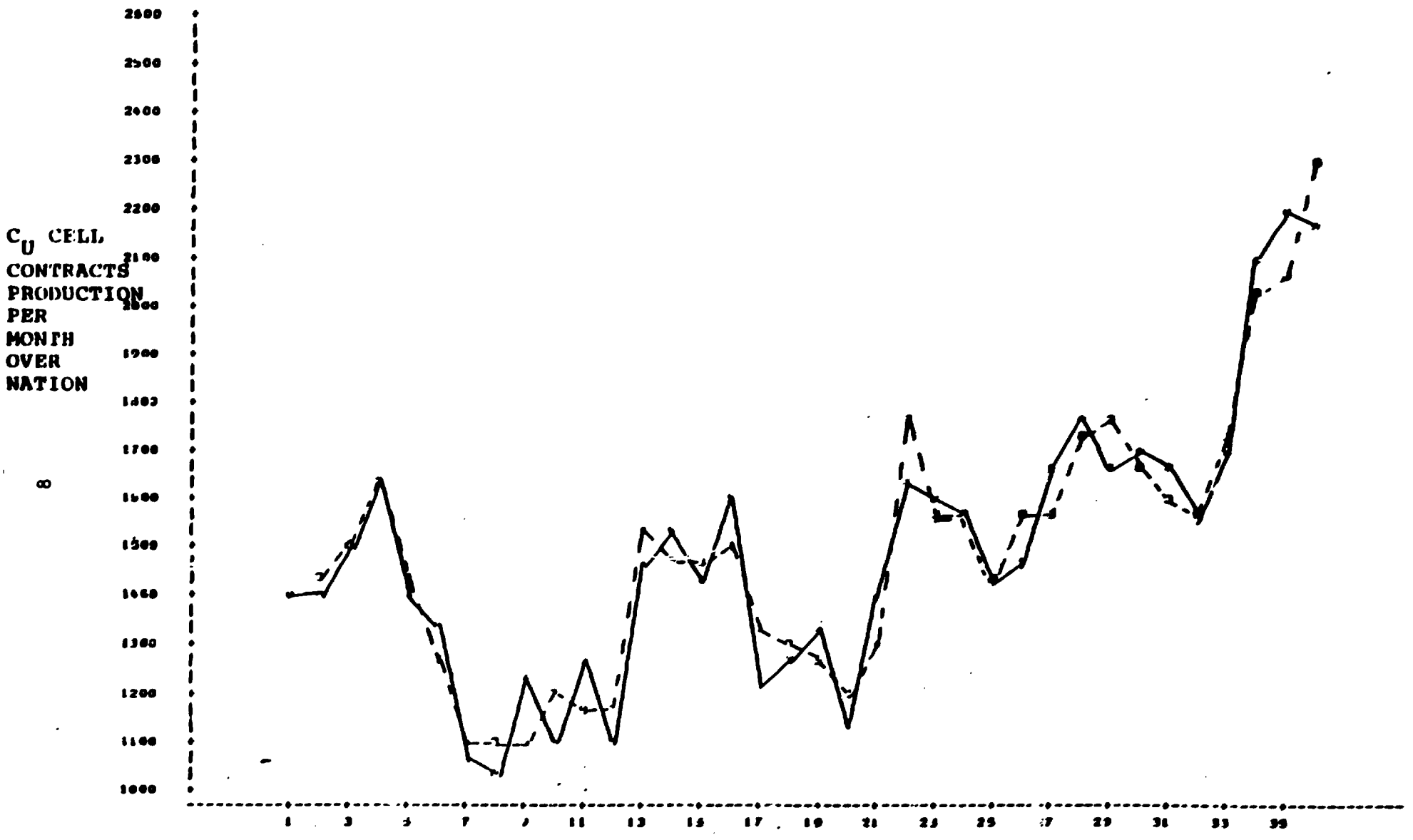


Figure 4: Variation in C_u cell contract production



3 and 4 regarding the variability of contract production. (The solid line represents the actuals whereas the dashed line is the predicted using the regression model of Section 3.1.)

v) Ratio of A cell DEPers to C_u cell DEPers was down from 2.82 in FY84 to 1.79 in FY86.

vi) The degree of "compactness" of DEP varies by time of year; e.g., 80% of those in DEP at the beginning of June will become an accession within the next 4 months, whereas only 46% of those in DEP at beginning of February will ship during the next 4 months. This reflects the large surge in accessions (shipments) during the summer months.

vii) The average percent of the accession goal two months out that is covered by DEP was down from 88% in FY84 to 71% in FY86. Finally Figure 2 shows the large variation in the average DEP size of type A per recruiter by month.

1.3 Key Issues of DEP Management Focused on in this Effort

i) What are the impacts of DEP size and its composition on contract production of various types?

ii) How does "compactness" of DEP affect contract production of various types?

iii) How do these impacts compare to the impacts of other Navy resources, e.g., recruiters, local advertising, national advertising, support costs, etc.

iv) What DEP levels, composition and DEP compactness policies would minimize total recruiting cost (i.e., recruiters, support cost, national advertising, local advertising) and yield the desired mix and number of contracts in a prespecified recruiting environment?

1.4 Related Management Issues of Interest

v) What are the appropriate levels and mixes of Navy national advertising, local advertising and support cost that would maximize their effectiveness, given a recruiting environment consisting of given numbers of recruiters, demographics, joint recruiting advertising levels, etc., and a prestated DEP management policy?

vi) If we consider the taxpayer or DoD's point of view where the level of recruiters is also a controllable resource with a payroll for taxpayers or DoD to meet, then what would be the optimal level of recruiters, Navy national advertising, local advertising, and support cost together that would minimize total expenditures and still meet a given mix and level of contracts in a prespecified recruiting environment (including a given DEP management policy)?

2.0 OVERVIEW OF DATA AND GENERAL INSIGHTS AVAILABLE

2.1 Types of Data Available

The data base analyzed is at the monthly, regional level for the three-year period, FY84-TY86. Since there are six Navy recruiting regions, we have a total of 36 x 6 = 216 monthly-region cells. Also during this period, there was a total of nearly 211K net* contracts of the male, nonprior service, active duty type.

The detailed data elements by month and region are:

i) For male, nonprior service, active duty enlistments, we have net contract production and DEP sizes broken down for five types of

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*Adjusted for attrition while in DEP. Attrition factors are of the order of 6-9%.

individuals (See Figure 1)**;

A cell: HSDG I-III Upper (over 50th percentile)

B cell: non-HSDG I-III Upper

C_u cell: HSDG III-lower (30th-50th percentiles)

C_ℓ cell: HSDG IV (20th-30th percentiles)

D cell: III lower and IV, non-HSDG;

ii) The number of on board recruiters by month by region;

iii) DEP "compactness" profiles, i.e., at the beginning of a given month for each region, we know for each of the next 12 outmonths, the <u>percent</u> of the total accession goal (for male, nonprior, active duty enlistments) anticipated to be met by deliveries from the DEP bank. (This is a 36x12x6 data base);

iv) The level of headquarters and field level support costs by region by <u>quarter</u>;

v) The level of national advertising <u>placement</u> cost by month by region;

vi) The level of local advertising expenditures by area by <u>quarter</u>;

vii) The ration of military pay to civilian pay (for 1st year recruits) by month by region;

**The classifications are based on the <u>unrenormed</u> Armed Services Vocational Aptitude Battery Exam scores since the contract data available had not been completely renormed. In order to provide some feeling for the impact of renorming in the aggregate, consider A cell contracts in FY86. The unrenormed test scores indicated that 45.28% of the recruits were A cell whereas the renormed test scores increased this to 47%. For FY85, the unrenormed data indicated 42.79% of the recruits were A cell; the renormed data corrected this to 49.88%. For FY84, the unrenormed data indicated 61.5% of the recruits being A cell; the renorming corrected this to 54.19%. For the important C_u cell (i.e., HSDG and 30-50th percentile in mental category), the numbers were: For FY86, 27.22% of recruits were thought to be of C_u type before renorming, whereas 27.52% indeed were; for FY85, 24.64% of the recruits were thought to be of C_u type when indeed 27.81% were; for FY84, 22.54% were thought to be of C_u type when indeed 27.3% were found to be of that type after renorming.

Table 2: Averages and Ranges over 36 Month Period for Key Demographics and Resource Levels at National Level

National	Average	Range
1) National Unemployment Rate	.0736	.0659-.0887 (34% range from lowest to highest)
2) Size of 17-21 year old male population (nationwide)	8.571M	8.465M-8.860M (4.6% range)
3) Size of Black, 17-21 year old population (nationwide)	1.167M	1.145M-1.184M (3.4% range)
4) NRC monthly local advertising expenditures	$115K	$96K-$185K
5) National total support cost/month (field and headquarters) for enlisted personnel*	$5.82M	$3.85M-$10.26M
6) Average ratio of military/civilian pay for 1st year recruits	1.227	1.152-1.284 (11.5% range)
7) Number of recruiters (nationwide)	3671	3274-4443 (36% range)
8) Navy national annual advertising placement cost for enlisted personnel (nationwide)	$7.42M	$4.26M in FY84 to $10.063M in FY86

*Includes national advertising, local advertising and RAD materials.

Table 3: Key Averages and Ranges Related to DEP and Contracts*

	36 Month Average	Ranges	(Oct.83)	(Sep.86)
1) Total DEP for all types	36,599	29,945 in Nov.85 45,708 in Feb.84	42,630	30,118
2) Total DEP for male, nonprior service, active duty	29,948	23,401 in Nov.85 39,210 in Feb.84	35,637	23,785
3) DEP size of A type enlistments	18,183	12,546 in Nov.85 27,007 in Jan.84	25,657	13,763
4) DEP size of B type enlistments	947	355 in Jul.84 1,777 in Sep.85	1,351	850
5) DEP size of C_u type enlistments	8,161	6,439 in Sep.86 9,720 in May 86	7,870	6,439
6) DEP size of C type enlistments	2,576	1,248 in Oct.83 3,399 in May 86	2,230	1,248
7) DEP size of D type enlistments	80	0 in Jun.84 531 in Dec.85	2	2
8) No. of on-board recruiters	3,671	3,274 in Jun.84 4,443 in Sep.86	3,693	4,443
9) Total DEP/recruiter	10.08	6.78 in Sep.86 13.53 in Feb.84	11.54	6.78
10) Total DEP of A cell/ recruiter	5.04	3.09 in Sep.86 7.96 in Feb.84	5.95	3.09
11) Total DEP of C_u cell/ recruiter	2.24	1.45 in Sep.86 2.80 in Feb.84	2.13	1.45
12) Contracts of A type/ recruiter per month	.633	Not available	.97	.78
13) Contracts of B type/ recruiter per month	.183	0 .27	.023	.154
14) Contracts of C_u type/ recruiter per month	.404	.315 .513	.380	.485
15) Contracts of C type/ recruiter per month	.180	.235 .835	.085	.235
16) Contracts of D type/ recruiter per month	.022	0 .008	.008	0

*All mental category data is unrenormed.

Table 4: Statistics Related to DEP Profiles or "Compactness" of DEP (over 36 months from FY84-FY86)

	36 Month Average	Av. for FY84	Range of FY84	Av. for FY85	Range for FY85	Av. for FY86	Range for FY86
Percent of next month's (1st outmonth) male, NPS, active duty accession goal to be met from DEP bank	.925	.9477	.75-1.109	.914	.715-1.063	.913	.69-.99
Percent of 2nd outmonth's male, NPS, ACDU accession goal to be met from DEP bank	.79	.78	.57-1.016	.776	.465-102.7	.69	.35-.94
Percent of 3rd outmonth's male, NPS, ACDU accession goal to be met from DEP bank	.66	.638	.37-.98	.643	.32-.96	.47	.25-.78

Table 5: Key Statistics by Fiscal Year

	FY84	FY85	FY86
1) Average 12 month unemployment rate	.0778	.0725	.0704
2) Average number of on-board recruiters (includes production and administrative recruiters)	3421	3547	4047
3) Pay ratio (military to civilian)	1.229	1.216	1.240
4) Yearly accession goal (male, NPS, active duty)	68,359	72,008	73,570
5) Local advertising expenditures (in FY86 dollars)	$1.477M	$1.51M	$1.779M
6) Navy national advertising (placement costs in FY86 dollars) for enlisted	$4.587M	$8.274M	$10.064M
7) Joint DoD advertising placement costs (in FY86 dollars)	$19.67M	$16.64M	$14.70M
8) Support cost for enlisted personnel (in FY86 dollars)			
a) Headquarters (excludes Navy national adv.)	15.27M	17.24M	21.29M
b) Field (excludes local adv.)			
c) Total	46.51M	55.02M	62.07M
9) Field level support cost per recruiter man year (in FY86 dollars)	$9,717	$10,651	$10,077
10) Average size of eligible population	8.791M	8.677M	8.544M
11) Average DEP size (male, 17-21 year old, NPS, AD)	35,023	28,517	26,303
12) Av. total DEP per recruiter	12.21	9.939	8.098

Table 5 (continued)

	FY84	FY85	FY86
13) Av. size of DEP of A cell	23,826	16,452	14,268
14) Av. size of DEP of B cell	474	1,062	1,296
15) Av. size of DEP of C_u cell	8,430	8,082	7,956
16) Av. size of DEP of C_ℓ cell	2,268	2,910	2,544
17) Av. DEP of type A per recruiter	6.96	4.64	3.52
18) Av. DEP of type C_u per recruiter	2.46	2.27	1.96
19) Average ratio of A cell to C_u cell DEPers	2.82	2.03	1.79
20) Average percent of next month access goal covered next month from DEP	.95	.909	.916
21) Average percent of accession goal 2 months out covered by DEP	.88	.779	.710
22) Average percent of accession goal 3 months out covered by DEP	.80	.550	.528
23) Average percent of accession goal 4 months out covered by DEP	.72	.547	.400
24) a) Total number of male, 17-21 old, NPS, AD contracts	64,413	66,970	79,313
b) A cell contracts	36,742(57%)	32,345(48.3%)	36,915(46.5%)
c) B cell contracts	4,877(8%)	9,971(15%)	9,276(12%)
d) C_u cell contracts	15,492(24%)	17,205(26%)	21,073(27%)
e) C_ℓ cell contracts	7,286(11%)	7,442(11%)	9,004(11%)
f) D cell contracts	16(.02%)	7(.01%)	3,045(3.8%)

Table 5 (continued)

	FY84	FY85	FY86
25) Number of male, 17-21 old, NPS, active duty contracts per recruiter man year	18.829	18.88	19.598
26) Average A cell contracts/ Recruiter per year	10.74	9.12	9.12
27) Average C_u cell contracts per recruiter per year	4.53	4.85	5.21
28) Average ratio of A cell production to C_u cell production (unrenormed data)	2.37	1.88	1.75

Table 6: Comparison of Resource Utilizations Over Three Fiscal Years

	FY84	FY85	FY86
1) Number of recruiter man years	3421	3547	4047
2) Total cost of recruiter using $32K per man year	$109.472M	$113.504M	$129.504M
3) Navy national advertising placement cost (in FY86 dollars)	$ 4.258M	$ 7.95M	$ 10.064M
4) Overhead rate for Navy advertising*	1.605	1.796	1.45
5) Navy national advertising expenditures (in FY86 dollars)	$ 6.834M	$ 14.278M	$ 14.593M
6) Local advertising expenditures (in FY86 dollars)	$ 1.447M	$ 1.51M	$ 1.779M
7) Field Support dollars for enlisted personnel (in FY86 dollars)	$ 33.24M	$ 37.78M	$ 40.78M
8) Headquarters support cost	$ 15.27M	$ 17.24M	$ 21.29M
9) Total expenditures (sum of items 2,5,6,7,8) in FY86 dollars	$166.26M	$184.31M	$207.947M
10) Total number of contracts	64,413	66,970	79,313
11) Average cost per contract (ratio of 8 to 9) in FY86 dollars	$ 2,581	$ 2,752	$ 2,621
12) % of contracts that are A cell	57%	48.3%	46.5%

*Provided by NRC's Advertising Section.

viii) Size of the 17-21 year old, male population by region by year;

ix) Percent of the 17-21 year old, male population that is Black, by region by year.

2.2 Averages and Ranges Over 36 Month Period

This section shows the substantial variation in the above measures, even at the national level. It is this variability in so-called "natural" experiments that enables regression analyses to attempt to sort out the separate effects of each factor. Table 2 deals with key demographics and resources. Table 3 with contracts and DEP levels different types, and Table 4 with DEP compactness profiles (dealing with relief from direct ship pressure).

2.3 Key Summaries by Year

This section summarizes the key measures by fiscal year in Table 5, and concludes with some general observations about performance changes during 84-86 and possible reasons for them. Table 6 shows a comparison of resource utilization by year.

The following are some general observations between FY84 and RY86 based on statistics from Table 5:

Changes in Recruiting Outcomes (refer to Table 5):

i) Yearly accession goal up by about 10K and total contracts up by about 15K;

ii Average total contracts per recruiter man year up slightly in FY86;

iii) Number of A cell contracts per recruiter man year down about 1 1/2*;

iv) C_u cell production per recruiter is down .7 recruits per year in FY86*;

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*The results do not reflect renorming.

v) Very large increases in B cell contracts and D cell contracts per recruiter, i.e., the non-high school diploma graduates.

Changes in Recruiting Environment:

vi) Unemployment rate about 10% lower in FY86 than in FY84, i.e., down from .078 to .070 (hence more difficult environment);

vii) Size of eligible population down slightly in FY86;

viii) Little change in military/civilian pay ratio;

Changes in Resources Expended:

ix) Number of recruiters up by 600 (18% increase);

x) National advertising placement cost more than doubled from FY84 to FY86;

xi) Local advertising cost increased by about 24% from FY84 to FY86.

Changes in DEP Management Considerations:

xii) Average DEP over year down by 9K and average DEP per recruiter down by about a third;

xiii) Composition of DEP, (in terms of ration of A cell DEPers to C_u cell (DEPers), dropped off by about 37%.

xiv) Compactness of DEP:

a) Average percent of next month accession goal covered by DEP down by about 5 percentage points;

b) Average percent of accession goal 2 months out covered by DEP down 17 percentage points;

c) Average percent of accession goal 3 months out covered by DEP down 27 percentage points;

d) Average percent of accession goal 4 months out covered by DEP down 32 percentage points.

3.0 ANALYTICAL MODELS (Specification Issues)

This section describes two different and complementary approaches for assessing the impacts of DEP policy on contract production of various types. Both approaches make use of the technique of simultaneous regression analysis where different sets of equations are estimated simultaneously (e.g., see Kmenta, 1986). This simultaneous feature is needed to capture dynamic interactions of the types displayed in Figure 3: DEP sizes of various types affecting future contract production of various types; contract porduction of a given type in a month affecting DEP size at the end of the month of the same type; contract production of various types affecting contract production of other types through substitution effects.

The results of estimating these models one covered in Section 4. Before looking at the results, consider the first approach to this difficult and convoluted problem.

3.1 A Behavioral Production Model (run at the monthly-regional level)

This model focuses on the factors that impact on the production of various types of contracts. The dependent (or left hand side) variables are the number of contracts produced of each type in each monthly-regional cell. The factors on the right side are, by region by month: the number of recruiters; level of field level support cost; headquarter's support cost; level of Navy local advertising, Navy national advertising, and Joint DoD advertising; key demographics (unemployment rate, size of male 17-21 year old population, percent of 17-21 year old population that is Black); ratio of military to civilian pay; size of DEP of various types, and the degree of relief from direct ship pressure in the previous months as measured by the percents of the previous months' accession quotas covered by shipments from DEP. Other independent variables are monthly dummies to capture seasonal

effects. The possible lag effect of the various variables was investigated through the use of the so-called Koyck model where the effect of lagged variables is assumed to be geometrically decaying. (More on this feature is discussed subsequently.) Hence the total model consists of 8 equations, 4 of which relate to the production of the i^{th} type of contract (i = 1 (A cell), i = 2 (B cell), i = 3 (C_u cell), i = 4 (C_ℓ cell))* as a function of the factors mentioned previously; the other 4 equations relate to the interaction between DEP levels and contract production of each type.

The next issue to be addressed is the specification of the model, i.e. Cobb-Douglas, linear, etc. After numerous discussions with Navy Recruiting Command personnel, it became clear that resources such as advertising, field level support cost, and dep characteristics alter or augment the basic capabilities of the recruiter. That is to say, there is an intrinsic or raw elasticity of an unaided recruiter (which we will define as α_0) which then can be "moderated" or enhanced by various levels of advertising, field support and dep policies. Hence we have a model where the overall resulting <u>elasticity</u> for recruiters is itself a function of the level of these other variables.

This model has the appealing advantage (unlike the standard Cobb-Douglas or log-log specification) that even if advertising is cut to 0, there will still be contract production. In addition this specification has the advantage that the resulting elasticity for recruiters is not a constant (as it is in the Cobb-Douglas model) but varies as the levels of these complementary resources vary. Hence the specification chosen involves the <u>elasticity</u> of recruiters as a linear function of other resources, i.e.

*The D type of contract was not included as its production is minimal.

(# of contracts of a given type obtained in a given region and quarter) = constant·(# of recruiters in region)$^{\alpha}$ where the constant depends on demographics, seasonal factors, headquarter expenditures, etc.

where α (the elasticity for # of recruiters) = $\alpha_0 + \alpha_1$ (level of national advertising in region) + α_2 (level of local advertising in region) + α_3 (level of field level support in region) + α_4 (size of DEP in region of type A) + α_5 (size of DEP in region of type B) + α_6 (size of DEP in region of type C_u) + α_7 (size of DEP in region of type D) + α_8 (percent of this month's regional accession goal scheduled to come out of DEP) + α_9 (percent of last month's regional accession goal scheduled to come out of DEP) + α_{10} (percent of the month's and region's accession goal 2 months ago scheduled to come out of DEP) + α_{11} (percent of the month's and region's accession goal 3 months ago scheduled to come out of DEP).

Observe that the parameters can be estimated from a linear regression by taking as the dependent variable the logarithm of the number of contracts, and as the independent variables: the logarithm of the number of recruiters, the level of national advertising x the logarithm of # of recruiters, the level of field support cost x the logarithm of the # of recruiters, etc.

To illustrate the estimation technique, consider the pair of equations for contracts of type A_j one of the 4 types of contracts included in the simultaneous 8 equation system. First consider the contract production relationship:

ln (contracts of type A obtained from region i during month j) = A_0 + α_0 ln (# of recruiters in field in region i at beginning of month j) + α_1 ($ of national Navy placement costs, inflation adjusted, expended in month j)

$+ \alpha_2$ ($ of local advertising placement costs, inflation adjusted expended during month j) x ln (# of recruiters in region i, month j)

$+ \alpha_3$ ($ of field support dollars for enlisted program, inflation adjusted, expended during month j in region i) x ln (# of recruiters in region i at month j)

$+ \alpha_4$ (size of DEP of type A in region i at beginning of month j-1) x ln (# of recruiters in region i at month j)

$+ \alpha_5$ (size of DEP of type B in region i at beginning of month j-1) x ln (# of recruiters in region i at month j)

$+ \alpha_6$ (size of DEP of type C_u in region i at beginning of month j-1) x ln (# of recruiters in region i at month j)

$+ \alpha_7$ ln (size of DEP of type C_ℓ in region i at beginning of month j-1) x ln (# of recruiters in region i at month j)

$+ \alpha_8$ ln (size of DEP of type D in region i at beginning of month j-1) x ln (# of recruiters in region i at month j)

$+ \alpha_9$ ln (% of j^{th} month's accession goal for region i covered by DEP) x ln (# of recruiters in region i at month j)

$+ \alpha_{10}$ ln (% of $(j-1)^{st}$ month's accession goal for region i covered by DEP) x ln (# of recruiters in region i at month j)

$+ \alpha_{11}$ ln (% of $(j-2)^{nd}$ month's accession goal for rgion i covered by DEP) x ln (# of recruiters in region i at month j)

$+ \alpha_{12}$ ln (% of $(j-3)^{rd}$ month's accession goal for region i covered by DEP) x ln (# of recruiters in region i at month j)

$+ \alpha_{13}$ ln ($ of headquarters support cost for enlisted program, inflation adjusted, expended during month j)

$+ \alpha_{14}$ ln ($ of Joint DoD advertising placement cost, inflation adjusted, expended during month j)

$+ \alpha_{15}$ ln (unemployment rate in month j)

$+ \alpha_{16}$ ln (size of 17-21 old population in month j)

$+ \alpha_{17}$ ln (% of 17-21 old population that is Black in month j)

$+ \alpha_{18}$ ln (ratio of military to civilian pay in month j)

+ 11 monthly dummies.

Note that some of the factors are assumed to moderate the recruiter elasticity whereas other factors affect contract production through a multiplication impact. The second equation for A type contracts is a balance equation relating DEP and contract production, namely:

(Size of DEP of type A at end of month j) $= \alpha'_0 + \alpha'_1$(size of DEP of type A at beginning of month j in region i)

$+ \alpha'_2$(# of contracts of type A obtained during month j in region i)

$+ \alpha'_3$(# of accessions of type A during month j, region i) (2)

In (2), one would expect (except for DEP attrition) that $\alpha'_0 = 0$, $\alpha'_1 = 1$, $\alpha'_2 = 1$, and $\alpha'_3 = -1$. Indeed this is about what occurs. In the Koyck modeling (to capture lagged effects), an additional term is added to the right side of (1); the term is the lagged number of contracts of type A, region i, in month (j-1) and has a coefficient denoted λ. This autoregressive, Koyck parameter, λ, is between 0 and 1, the assumption being that contract production in month j is a function of sizes of DEP at the beginning of month j, month j-1, month j-2...etc., where the weights for the i^{th} lagged months are of the form $(1-\lambda)\lambda^i$. Hence contracts signed in the j^{th} month may be due to the number of recruiters, or DEP size, many months earlier. The estimation procedure focuses on the short term or immediate impacts of the various factors on contract production. The long term impact is obtained from the short term

impact by dividing the short term impact by $1-\lambda$. The impact has an average lag given by $\lambda/1-\lambda$; also the length of the lag such that 95% of the total impact is realized is given by $\log_e .05/\log_e \lambda$. The parameter estimates and insights from this model are given in Section 4.1.

The parameter estimates from the specifications of this model, i.e. the behaviorial model of Section 3.1 is discussed in Section 4.1. The next section, Section 3.2, deals with an alternative specification form, the results of which are in Section 4.2.

3.2 Optimized Cost Allocation Models

Our second approach to this interesting and difficult problem is to focus on the efficient utilization of each of the four resources, i.e., recruiters, support cost, Navy national advertising and local advertising. In this context, we are interested in the cost impacts of managing DEP differently in terms of its size, composition and compactness (through its role in providing relief from direct ship pressure). One of the key differences between this analysis and the previous analysis is that the number of contracts produced of various types will appear as independent variables (right hand side variables), in contrast to the previous analysis of Section 3.1 where they were the dependent (left hand side) variables. This approach will also provide insights on the degree of substitution possible between various types of enlistments, with no change required in the level of recruiting resources being expended.

We shall think of the recruiting process as a production process, the outputs of which are produced and sold by means of production inputs, the environment, and management decisions. The outputs will be 5 in number and will be the number of the five different types of contracts produced, i.e., A,

B, C_u, C_ℓ, and D type contracts. The production inputs will be recruiters, Navy national advertising, local advertising and support cost. These will be "public" in nature in the sense that they influence production of all outputs, and are not allocable to specific types of contracts. The environment will consist of demographics (population, unemployment rate, percent black), uncontrollable resources (Jador expensitures and military/civilian pay ratios). The management variables will relate to DEP policy dealing with size, composition and compactness of DEP.

We wish to address the following issues:

i) Given exogenous contract targets by type (i.e., number and mix), for some given period, e.g., next FY;

ii) a prespecified hypothesized recruiting environment for the time period of interest consisting of: size of eligible population, percent Black, and unemployment rate;

iii) hypothesized levels of other non-controllable resources (joint DoD advertising expenditures and military/civilian pay ratios) to be expended for the period of interest;

iv) the prices per unit of application for each type of recource, e.g., price of a recruiter man year, overhead factors for a dollar of placement cost of various types of advertising, etc.;

v) management policies concerning DEP, regarding initial and average sizes of DEP, composition of DEP, and "compactness" of DEP.

Then given (i) - (v), we wish to determine the cost-effective allocation of each resource to meet the levels of contracts required and the total minimum cost needed. We also wish to gain some quantitative insights on the monetary impacts of altering DEP policy.

The following formal optimization problem will facilitate the discussion of the model:

Let Y represent an exogenous vector of contracts required for each of the five types of contracts for some upcoming period, e.g., next quarter, next fiscal year, etc. Let $X = (x_1, x_2, x_3, x_4)$, a vector, represent the level of units of each of the four monetary resources (recruiters, support cost, Navy national advertising, local advertising) required to be expended to meet Y. Also let Z be a vector of environmental variables, e.g., size of 17-21 years old population, percent of eligible population that is black, unemployment rate, level of Joint DOD military advertising, military/civilian pay ratios, and seasonal dummies. Finally, let D denote DEP management variables related to size of DEP of each type, percent of this month's and previous 3 months' accession quotas covered by DEP. Then a production technology is represented by a production possibilities set $T(Y,X,Z,D) \leq 0$ which shows all (X,Z,D) vector combinations capable of producing each Y vector. Finally, suppose the controllable resource X vector has unit costs given by the vector $P = (p_1, p_2, p_3, p_4)$. Then the cost allocation optimization problem is: given Z and D, select X so as to minimize PX subject to $T(Y,X,Z,D) \leq 0$. The sclution to the above is an optimal resource utilization vector X(Y,P,Z,D) and minimized total resource cost $K(Y,P,Z,D) = P \cdot X(Y,P,Z,D)$. The resource cost function K(Y,P,Z) describes the minimum total cost require to produce outputs Y at resource unit costs P, in the environment Z and DEP policy philosophy reprsented by Z.

For the theory sketched to be applied to the Navy problem, it is necessary to endow the minimum incentive cost function with functional structure and to specify an estimation technique. The structure should be sufficiently flexible to impose no properties on recruiting technology that are unwarranted by the data. It should also be sufficiently simple to be tractable empirically in light of the size of the data base relative to the number of included explanatory variables.

A flexible second-order logarithmic specification, dubbed translog, is attractive because comparative static effects are easily represented by elasticities, which facilitate comparisons across different experiments. A simplified translog incentive cost function can be written as:

$$\ln K = a_0 + a_1 \ln y_1 + a_2 \ln y_2 + a_3 \ln y_3 + a_4 \ln y_4 + a_5 \ln y_5 + \sum_{i=1}^{4} b_i \ln p_i$$

$$+ c_1 (\ln(y_1))^2 + c_2 (\ln(y_2))^2 + c_3 (\ln(y_3))^2 + c_4 (\ln(y_4))^2 + \sum_{i=1}^{21} g_i \ln z_i, \quad (3)$$

$$+ \sum_{j=1}^{4} \ell_j \ln(d_j) + \ell_9 (\ln(d_1))^2 + \ell_{10} (\ln(d_3))^2 + \ell_{11} (\ln(d_1)(\ln R) + \ell_{12} (\ln(d_3)(\ln R)$$

where $K = \sum_{i=1}^{4} p_i x_i$.

Where Y_j = number of contracts

(j=1,2,3,4) where j=1 denotes A cell contracts, j=2 denotes B cell contracts, j=3 denotes C_n cell contracts and j=4 denotes C_ℓ cell contracts and j=5 denotes D cell contracts),

d_j = size of the delayed entry program of type j (lagged 2 months) where j=1,2,3,4*

Z_i (i=1,2,...,21) include environmental variables (size of eligible population, percent Black, local unemployment rate), levels of other military resources not included in the left hand side cost function (e.g. level of recent DoD military advertising expenses, Navy Recruiting Command Headquarters cost, ratio of military to civilian pay ratios), variables related to DEP profiles (i.e. percent of various past months' accession goals covered by DEP).

The detailed definitions are:

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* This was done to allow the peer network the lead time to convert referrals to contracts. This lag was varied between 0 and 4 to capture the lag which gave rise to the largest R^2.

$K = \sum_{i=1}^{4} p_i X_i$ equal the total cost of the resources expended (in each monthly-regional cell excluding headquarter's support cost);

y_1 = number of contracts of A type obtained, in each area-monthly cell;

y_2 = number of contracts of B type obtained in each cell;

y_3 = number of contracts of C_u type obtained in each cell

y_4 = number of contracts of C_ℓ type obtained in each cell

y_5 = number of contracts of D type obtained in each cell

p_1 = cost per unit of local advertising placement costs (this was assumed to be 1 and was inflation adjusted, using the last quarter of FY86 as the base)

p_2 = cost per unit of national advertising placement costs (inflation adjusted); these utilized overhead rates of 60.5% for FY84, 79.6% for FY85, and 45.0% for FY86 and were obtained from the Navy's Advertising Section)

p_3 = cost per unit of field level support cost (this was assumed to be 1 and was inflation adjusted)

p_4 = cost per man-month of each recruiter (this was assumed to be $2,667 in FY86 dollars and was inflation adjusted)

z_1 = size of 17-21 year old, male population in each cell

z_2 = percent black of 17-21 year old, male population in each cell

z_3 = level of Joint DOD placement costs expended in each cell

z_4 = local unemployment rate in each cell

z_5 = level of military/civilian pay ratio in each cell

z_6 = level of Headquarters support cost

$z_7 - z_{17}$ = monthly dummies

d_1 = size of DEP of type A recruits 2 months earlier in each cell

d_2 = size of DEP of type B recruits 2 months earlier in each cell

d_3 = size of DEP of type C_u recruits 2 months earlier in each cell

d_4 = size of DEP of type C_ℓ recruits 2 months earlier in each cell

z_{18} = percent of this month's accession goal scheduled to come out of DEP in this cell

z_{19} = percent of last month's accession goal scheduled to come out of DEP in this cell

z_{20} = percent of accession goal 2 months ago scheduled to come out of DEP by cell

z_{21} = percent of accession goal 3 months ago scheduled to come out of DEP by cell

R = number of recruiters present in each cell

Thus, total resource cost by cell is influenced by the number of contracts desired by type, the prices per unit of various types of resources available, the environmental variables, the month, the usage of the joint DoD advertising, and various DEP management characteristics.

Efficient utilization of each monetary resource x_i included in the left hand side costs is imposed in the model from a fundamental result in mathematical programming: the effect on the <u>optimal</u> value of the objective function of a slight relaxation in a constraint is equal to the optimal value of the endogenous variable whose constraint is relaxed. In the present context, this result states that at optimality the change in minimized total resource cost caused by a change in a resource's per unit price is equal to the optimal utilization of the resource mechanism whose price changes. This result, known as Shephard's Lemma (see e.g., Varian (1984; 54)) can be stated as:

$$x_i^* = \frac{\partial K^*}{\partial p_i} \quad \text{(the asterisk denotes the optimal values of } x_i \text{ and K)} \qquad (4)$$

By adding the equations of (4) (one for each resource) to that of (3), efficient utilization of each resource type is induced. In addition, since the

cost function (3) is logarithmic, it proves easier to work with resource cost share equations rather than (4). From (4), we have $\partial(\ln K)/\partial(\ln p_i) = (\partial K/\partial p_i)(p_i/K) = p_i x_i/K$ for all i. Hence the optimal fraction of the total resource cost that should be allocated to the i^{th} monetary incentive from (3) is given by:

$$p_i x_i/K = b_i \quad (i=1,2,3,4) \tag{5}$$

where b_i is the coefficient of p_i in equation (3).

It should be stressed that the left sides of (3) and (5) in the econometric estimation utilize the observed values. The right sides, exclusive of the error terms, represent the efficient levels. The residual error terms represent the differences between the two.

When the right hand side of equation (5) is forced to have the same value as the coefficient of p_i in (3), we are imposing the necessary conditions for allocative efficiency in the Navy's allocation of resources. When that restriction is not forced as part of the estimation technique, any differences in the estimated parameters reflect the extent of allocative inefficiencies present in the Navy's past allocations.

The statistical problem is to estimate the parameters in each of the equations. Since cost shares sum to unity, one cost share equation is redundant, leaving 8 independent equations. Hence the following constraint holds:

$$b_4 = 1 - \sum_{i=1}^{3} b_i .$$

This parametric restriction enables us to normalize total resource cost and all per unit resource prices by the 4^{th} resource unit prices, i.e. p_4. Imposing this normalization and adding disturbance terms to all 8 equations generates the system to be estimated. Note that the parameters (b_1, b_2, b_3)

appear in two equations, the cost function (1) and its i^{th} cost share equation when allocative efficiency assumptions are imposed. Cross-equation restrictions must be imposed if we wish to assure that these parameters have the same estimate in both equations.

Writing the system in compact form, we have

$$Y = X\beta + \varepsilon ,$$

where Y is a vector of dependent variables, X is a matrix of explanatory variables, β is a parameter vector to be estimated, and ε is a disturbance vector. The disturbance vector is assumed to satisfy

$$E(\varepsilon) = 0,$$

$$E(\varepsilon\varepsilon') = \Sigma \otimes I, \qquad (6)$$

where $\otimes$ denotes the Kronecker product and $\Sigma = [\sigma_{ij}]$ is a symmetric and positive definite matrix. Nonzero off-diagonal elements of Σ signal correlated disturbances across equations, and suggest that the equations in the system are only "seemingly unrelated", being related through their disturbance terms, perhaps as a consequence of omitted variables.

The parameters in the system can be estimated by ordinary least squares applied to each equation separately. Under assumptions (6) the parameter estimates are unbiased and consistent. They are not efficient, however, because they ignore the interdependence among equations caused by correlated disturbances. A systems estimator is called for. Several are available, the most popular of which is Zellner's "Seemingly Unrelated Regressions" technique. In this two-step method, each equation is estimated separately by ordinary least squares, after which the ordinary least squares residuals are used to form a consistent estimator $\Sigma = [s_{ij}]$ of Σ. This estimator is unbiased, consistent, and asymptotically efficient.

We observe the following important uses of the model:

i) $\frac{d \ln K}{d \ln y_j} = a_j + 2c_j \ln y_j$ is the elasticity of the j^{th} type of contract on the minimum total cost needed. Hence the impact on total minimum cost of an increase or decrease of 1% in any given type of contract can be easily computed.

ii) b_i, i.e., the right side of (5), is the efficient percent of the total recruiting cost that should be spent on resource i.

iii) g_i represent elasticities of the i^{th} environmental factor on total minimum recruiting costs. Hence the impact e.g. of the impact of unemployment changes on total recruiting cost can be determined.

iv) Note that the impact of changing the dep profiles (i.e. the compactness of dep) can be estimated also from the coefficients of the variables that deal with the percent of accession goals that are covered from dep.

v) Note that the minimum cost depends on the size of the DEP of various types. We shall utilize this information to arrive at the optimal size of DEP of A type and C_u type, to minimize total recruiting costs.

The parameter estimates from the efficient allocation specification (of Section 3.2) are presented in Section 4.2.

4.0 RESULTS OF EXERCISING MODELS OF SECTION 3 ON FY84-FY86 DATA

4.1 Estimation of Parameters from Behavioral Production Model fo the Period FY84-FY86 (see Section 3.1 for the technical development)

Table 7 displays the beta estimates and t statistics (in parentheses) for the key two classes of contracts, i.e. A cell and C_u cells. This table is followed by a discussion of quantitative insights as to the impacts of various factors on various types of constract production.

Table 7 Estimation of Key Parameters for Behavioral Model
(see Section 3.1 for technical development)

DEPENDENT VARIABLE	(Model 1) ln(Contracts of Type A)	ln(Contracts of Type C_u)
INDEPENDENT VARIABLES		
Intercept	13.87 (3.73)	8.88 (1.72)
Koyck parameter	.288 (3.94	.059 (.98)
ln(recruiters)	1.44 (4.71)	1.15 (2.73)
Size of DEP of A type x ln(recruiters)	.000091 (2.82)	-.000012 (-.28)
Size of DEP of B type x ln(recruiters)	-.00023 (-1.52)	-.00016 (-.77)
Size of DEP of C_u type x ln(recruiters)	.000006 (.75)	.00019 (1.65)
Size of DEP of C_l type x ln(recruiters)	-.000018 (-.82)	-.00005 (-1.67)
Size of DEP of D type x ln(recruiters)	-.00005 (-.84)	.00009 (1.05)
Percent of last month's accession goal covered by DEP x ln(recruiters)	.00001 (.89)	.00009 (2.02)
Percent of accession goal 2 months ago covered by DEP x ln(recruiters)	-.00002 (-.05)	.0002 (.52)
Percent of accession goal 3 months ago covered by DEP x ln(recruiters)	-.0002 (-.93)	.0005 (1.18)
Dollars of field support dollars x ln(recruiters)	-3.25×10^{-8} (-1.33)	-1.63×10^{-9} (-.04)
Dollars of Navy National Advertising x ln(recruiters)	2.35×10^{-8} (.57)	6.9×10^{-8} (1.17)
Dollars of Local Advertising x ln(recruiters)	7.759×10^{-7} (2.03)	.0000011 (2.0622)
Dollars of Joint DoD Advertising x ln(recruiters)	5.404×10^{-9} (.75)	-5.49×10^{-10} (-.01)

ln(Size of eligible population)	.79 (3.53)	.46 (2.73)
Percent of eligible population that is Black	-.189 (-3.3)	-.028 (-.35)
ln(headquarters support cost)	.035 (1.42)	-.09 (-2.66)
ln(local unemployment rate)	.37 (4.12)	.426 (3.41)
ln(ratio of military/ civilian pay ratios)	-1.16 (-2.07)	.47 (.599)
January monthly dummy	.062 (.92)	.058 (.501)
February monthly dummy	-.11 (-1.38)	-.299 (-2.6)
March monthly dummy	-.105 (-1.63)	-.175 (-1.9)
April monthly dummy	-.17 (-1.97)	-.20 (-1.62)
May monthly dummy	-.29 (-3.40)	-.28 (-2.2)
June monthly dummy	-.107 (-1.16)	-.02 (-.17)
July monthly dummy	.08 (.77)	-.16 (-1.07)
August monthly dummy	.056 (.55)	-.24 (-1.67)
September monthly dummy	-.205 (-1.76)	-.30 (-2.19)
October monthly dummy	-.09 (-1.03)	-.147 (-1.09)
November monthly dummy	-.128 (-1.71)	-.063 (-.59)
Dummy for FY84	-.038 (-.28)	-.107 (-.56)
Dummy for FY85	.03 (.459)	.08 (.90)

Discussion of Quantitative Insights from Behavioral Model 3.1
for Contract Production of A Type

i) The length of lagged effect (for 95% of total effect based on parameters of Table) of resources and DEP policies to be felt) is 2 months for A cell contracts.

ii) The raw recruiter elasticity, related to A cell production, is 1.44; the total recruiter elasticity (in FY86) on A cell production was 1.67. Hence the levels of other resources and DEP policy improved the raw elasticity of recruiters (relative to A cell production) by 16%.

iii) The estimated incremental gain to the raw recruiter elasticity on A cell contract producter from the average size of DEP of type A in FY84 was .21* or an increase of 15%. This is statistically significant at the .005 level of significance. Hence recruiters were 15% more effective in FY84, relative to production of A cell contracts with the A cell DEP they had than they would be with none. Upon working out the elasticity of A cell DEP on A cell production (i.e. $\frac{d \ln(\text{A})}{d(\text{DEP A})}$), one arrives at 1.4 for FY 86. Recall that in FY86 there was an average of 2,378 DEPers of type A in each region and also each region was obtaining an average of 512 A cell contracts per month. Hence the 1.4 elasticity implies that 23.78 more A cell DEPers in a region in the steady state would lead to 7.17 A cell contracts per region per month; this implies a "referral" rate of about .3 referrals of A type per marginal member of DEP of the A type.

iv) The incremental impacts to the raw recruiter elasticity on A cell production of changes in the other types of DEP are insignificant.

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*This comes about since average size of DEP of type A over FY86 was 14,268, yielding an average per region of 2,378. This number multiplied by the coefficient of (DEP of type A x log recruiters) i.e. .000091, yields .21.

v) The incremental impact to the raw recruiter elasticity on A cell production of changes in local advertising expenditures in FY86 was .019 (i.e. a change of about 1%); this is significant at the 4% level of significance. This implies an elasticity for local advertising of .123 on A cell production since $\frac{d(\ln y_A)}{d(\text{local advertising})} = \alpha_2 \times (\text{local advertising}) \times \ln (\#\text{ of Recruiters})$.

vi) The estimated incremental impact of national advertising expenditures on the elasticity for recruiters on A cell production in FY86 is estimated to be .0032.** This implies an elasticity for national advertising on A cell production in FY86 of .02.

vii) The elasticity of the local unemployment rate on A cell production is .372 and significant at the .01% level of significance.

viii) The elasticity of size of eligible population is .79 (and significant at the .05% level) and shows the fact that reductions in the size of the eligible population (i.e. male, 17-21 year olds) lower A cell production, but not at a proportionate rate.

ix) The elasticity of the percent of eligible population that is Black on A cell production is -.19 and very significant. This confirms the conventional wisdom that the highest quality recruits are not to be found in the areas of high Black concentrations.

x) The compactness of DEP, i.e. relief from direct ship pressure doesn't seem to effect A cell production, but it does the important IIIB's, HSDG's (i.e. C_u cell).

xi) The elasticity of headquarter's support cost on A cell production is .035, but significant only at the 15% level of significance.

**The t value is only .57 so it is not statistically significant.

Discussion of Quantitative Insights from Behavioral Model 3.1 for Contract Production of Type C_u (based on parameters of Table 7)

i) The length of the lagged effect (for 95% of total effect to be felt) is 1 month. Hence lagged effects persist longer for the higher quality recruit, perhaps reflecting the longer time needed for decision making for this type of recruit with more options.

ii) The raw recruiter elasticity is 1.15 for C_u cell production and very significant. Note that the comparison of the elasticities (namely 1.44 for A cell) suggest that recruiter input is relatively more important for the A cell contracts than for the C_u cell contracts. Again this is consistent with conventional wisdom.

iii) The estimated incremental gain to the raw recruiter elasticity on C_u cell production from the size of the C_u cell DEP using FY86 averages is .242 or a 22% gain. This comes about since the average size of DEP of type C_u over FY86 was 7,956, yielding an average per region of 1,326. This multiplied by the coefficient of (DEP of type C_u x ln (recruiters)), i.e. .00019, yields .219. This implies the estimated elasticity of C_u cell DEP on C_u cell production (for FY86) was 1.64. Recall that in FY86, the average C_u cell DEP was 7,956 or 1,326 per region. Recall also that the annual national contract production of C_u cell contracts was 21,073 for a monthly, regional rate of 292.68. Hence the elasticity of 1.64 implies that 13.26 more DEPers on the average in each region will yield (.0164)(292.68) = 4.8 more C_u cell contracts monthly, for a "referral" rate of .36 referrals per C_u DEPer.

iv) The estimated impacts of other cell types on C_u cell production is insignificant.

v) The incremental impact to the raw recruiter elasticity on C_u cell production of changes in local advertising expenditures in FY86 was .027 (or a change of 2.4%). This is significant at the 4% level of significance. The estimated elasticity of local advertising expenditures on C_u cell production is .176; this is higher than is the case for A cell production as might be expected since much of the local advertising is geared at classified ads that may appeal more to the lower quality recruit.

vi) The estimated incremental impact of Navy national advertising expenditures on the elasticity for recruiters, related to C_u production in FY86 would have been .0096, but only significant at the 24% level. The elasticity for national advertising or C_u cell production is estimated at .06.

vii) The estimated elasticity of the local unemployment rate on C_u production is .426 (significant at .08%).

viii) The elasticity of headquarters support cost on C_u cell productin is -.09 (and significant at .84% level), capturing perhaps the substitution phenomena that higher headquarter's expenditures leads to more A cell contracts and hence less C_u production is needed.

ix) The estimated impact on the recruiter elasticity of relief from direct ship pressure one month earlier, on production of C_u type contracts is .00086 (i.e. a .08% increase) and is statistically significant.

x) The estimated impacts of other resources (pay, percent Black, Joint DoD advertising expenditures, etc.) were insignificant.

Table 7-1:

SUMMARY OF ESTIMATED ELASTICITIES FROM BEHAVIORAL MODEL

(Evaluated at Means of FY86 Levels)

Factor	A Cell production	C_u Cell production
Raw Recruiter	1.44	1.15
Supported Recruiter	1.67	1.44
Local Advertising	.123	.176
National Advertising	.02*	.06*
DEP size of type A	1.4 (.3 referrals per DEPer)	0
DEP size of type C_u	0	1.54 (.36 referrals per DEPer)
Local Unemployment Rate	.37	.426
Eligible Population	.79	.46
Percent Black	-.19	0
Field Level Support Cost	0	0
Headquarter Support Cost	.035	-.09
Compactness of DEP	0	.005

*Not significant at 5% level

Decision Insights for Production of Other Contract Types from Model 3.1

i) One of the only 2 statistically significant variable (other than some of the monthly dummies) for production of B cell contracts was local advertising. This was estimated to increase the raw recruiter elasticity (estimated at 0) by .24 in FY84).

ii) The other statistically significant variable was for Headquarters support cost at -.67, capturing as before perhaps the substitution effect between high school degree contracts and non-high school contracts.

iii) Consider production of C_ℓ contracts:

a) Increases in DEP of type A, C_ℓ, and D types appear to have statistically significant effects on contract production of C_ℓ type. As an example the estimated "referral rate" of C_ℓ type contracts by A cell DEPers is .25. The other referral rates are difficult to estimate because of the small size of DEP of C_ℓ and D type.

b) The percent of population that is Black has a positive impact on C_ℓ contract production, the elasticity being .45.

c) The elasticity of local advertising on the production of C_ℓ type of contract is .436.

4.2 Estimation of Parameters from Efficient Cost Models for period FY84-FY86 (see Section 3.2 for the technical underpinnings)

A total of 3 runs were made with this basic approach:

Model 2A: Recruiter's cost on a per man-year basis (salary and benefits) were included (even though the salaries of the recruiters are not part of the Navy Recruiting Command's Budget); also the necessary conditions for efficiency were imposed.

Model 2B: Per man year recruiter costs were excluded; necessary conditions for efficiency imposed.

Model 2C: Same as 2B, but necessary conditions for efficiency relaxed. Note that in models 2B and 2C, there is one less cost share equation since the number of recruiters is assumed to be exogenous.

Table 8 contains the estimated parameters from the 3 models. In addition Tables 9 and 10 display respectively the dollars and proportions of the budget actually spent in the individual 3 years, as well as the estimated efficient levels from the regression analysis. We observe from Table 10 (recruiter cost excluded), e.g. that the percent of NRC's enlisted funds (exclusive of headquarters expense) devoted to enlisted Navy advertising has grown from 16.5% in FY84 to 25.5% in FY86 at the expense of field level support for recruiters. When the necessary conditions for efficiency are imposed, the efficient share of field support costs is estimated to be at 76.12%, versus 20.8% for Navy national advertising and 3.1% for local advertising. When the necessary conditions for efficiencies are relaxed, the model suggests Navy advertising at the 50% level, at the expense of the field support cost. In other words, when possible inefficiencies in past allocations were taken into account, the models suggest an increase in Navy national advertising at the expense of field level support cost. The result is consistent with the analysis of 4.1 where field support expenditures appeared to have little impact on the recruiter elasticity for different types of contracts.

Table 8

Third Stage Regression Parameters from Efficient Cost Regression Models (multiequation system): dependent variable is the logarithm of total recruiting costs

Variable	Parameter Estimates & T Ratios for Model 2A (recruiter cost included and necessary conditions for efficiency imposed)	Parameter Estimates & t Values for Model 2B (recruiter cost excluded and necessary conditions for efficiency imposed)	Parameter Estimates & T Values for Model 2C (recruiter cost excluded and efficiency conditions relaxed)
Intercept	1.22 (.92)	.685 (.207)	3.15 (.907)
ln (contracts of A type)	.064 (1.53)	3.57 (3.65)	3.30 (3.35)
ln (contracts of B type)	-.003 (-.97)	-.007 (-.82)	-.01 (-1.26)
ln (contracts of C_u type)	-1.18 (-3.83)	.336 (.41)	.55 (.67)
ln (contracts of C_ℓ type)	-.12 (-1.79)	.185 (1.09)	.22 (1.29)
ln (contracts of D type)	.002 (7.37)	-.00027 (-.28)	.001 (.93)
ln (price per unit for local advertising)	.0094 (63.98)	.031 (42.89)	.031 (1.57)
ln (price per unit for Navy National Advertising)	.067 (19.65)	.208*	.508*
ln (price per unit for Field Level support cost)	.235 (103.7)	.761 (77.53)	.461 (3.45)
$(\ln(\text{contracts of type A}))^2$	-.04 (-1.26)	-.297 (-3.71)	-.27 (-3.42)
$(\ln(\text{contracts of type B}))^2$	-.0004 (-1.58)	-.0005 (-.73)	-.0009 (-1.25)
$(\ln(\text{contracts of type } C_u))^2$	.116 (4.04)	-.029 (-.37)	-.049 (-.65)
$(\ln(\text{contracts of type } C_\ell))^2$	.014 (1.74)	-.022 (-1.13)	-.026 (-1.29)
ln(Size of dep of type A) 2 months earlier	.929 (1.89)	.71 (.58)	.39 (.32)
ln(Size of dep of type B) 2 months earlier	.032 (3.87)	.036 (1.69)	.022 (1.04)
ln(Size of dep of type C_u) 2 months earlier	-.829 (-1.66)	-.62 (-.50)	-.44 (-.35)

* The t values not available as it is calculated as the complement of the other two estimated parameters

Table 8 cont.

Variable	Parameter Estimates & T Ratios for Model 2A (recruiter cost included and necessary conditions for efficiency imposed)	Parameter Estimates & t Values for Model 2B (recruiter cost excluded and necessary conditions for efficiency imposed)	Parameter Estimates & T Values for Model 2C (recruiter cost excluded and efficiency conditions relaxed)
ln (Size of dep of type C) 2 months earlier [1]	.0033 (.75)	.058 (1.81)	.05 (1.6)
$(\ln (\text{dep of type A}))^2$ 2 months earlier	-.29 (-9.12)	-.13 (-1.41)	-.014 (-.13)
$(\ln (\text{dep of type C}))^2$ 2 months earlier [1]	.311 (9.03)	.14 (1.42)	.014 (.12)
ln (dep of type A) • ln (# of recruiters) 2 months earlier	.573 (7.84)	.215 (1.04)	-.03 (-.14)
ln (dep of type C) • ln (# of recruiters) 2 months earlier [1]	-.581 (7.37)	-.23 (-1.055)	.032 (.13)
ln (Recruiters)	not applicable	1.41 (6.46)	1.69 (6.75)
ln (Size of eligible male population)	.526 (9.36)	-.51 (-2.63)	-.71 (-3.32)
ln (percent of eligible population that's Black)	.031 (2.47)	-.11 (-3.27)	-.15 (-3.95)
ln(level . Joint Dod Advertising expenses)	-.0003 (-.04)	-.029 (-1.87)	-.03 (-1.91)
ln(level of Navy Recruiting Command Headquarters cost)	-.0016 (-1.36)	-.003 (-1.17)	-.0025 (-.89)
ln(local unemployment rate)	-.048 (-1.71)	-.058 (-.82)	-.008 (-.11)
ln(ratio of military/civilian pay ratio)	-.069 (-.49)	-1.65 (-4.73)	-1.39 (-3.3)
ln(Percent of this month's accession goal covered by dep)	-.09 (-1.94)	-.167 (-1.44)	-.17 (-1.47)
ln(percent of last month's accession goal covered by dep)	.046 (.93)	.474 (3.76)	.46 (3.67)
ln(percent of accession goal 2 months ago covered by dep)	-.028 (-.49)	-.069 (-.54)	-.06 (-.49)
ln(percent of accession goal 3 months ago covered by dep)	-.097 (-1.99)	-.565 (-4.64)	-.55 (-4.5)

Table 8 cont.

Variable	Parameter Estimates & T Ratios for Model 2A (recruiter cost included and necessary conditions for efficiency imposed)	Parameter Estimates & t Values for Model 2B (recruiter cost excluded and necessary conditions for efficiency imposed)	Parameter Estimates & T Values for Model 2C (recruiter cost excluded and efficiency conditions relaxed)
January Monthly dummy	-.025 (-1.36)	.26 (1.29)	.04 (.88)
February Monthly dummy	.13 (6.78)	.396 (7.69)	.37 (7.16)
March Monthly dummy	.09 (4.51)	.278 (5.51)	.26 (5.23)
April Monthly dummy	.15 (5.01)	.33 (.37)	.31 (4.00)
May Monthly dummy	.133 (2.81)	.044 (.37)	.021 (.17)
June Monthly dummy	.019 (.34)	-.33 (-2.59)	-.35 (-2.74)
July Monthly dummy	-.039 (-.56)	-.44 (-2.91)	-.47 (-3.11)
August Monthly dummy	.056 (1.06)	-.011 (-.088)	-.04 (-.30)
September Monthly dummy	.188 (4.06)	.242 (2.07)	.215 (1.83)
October Monthly dummy	.171 (9.06)	.554 (11.81)	.56 (11.92)
November Monthly dummy	.098 (5.41)	.31 (6.90)	.32 (7.05)

Table 9: Comparison of Resource Utilization with Percentages by Year (cost of recruiters included; same as situation in Model 2A)

Levels	FY84	FY85	FY86	Estimated "Efficiency" Levels from Model 2A
Total resources expended, exclusive of Headquarters support cost	$150.99M	$167.06M	$186.65M	
Dollars and percent devoted to local advertising	$1.447M (.96%)	$1.51M (.90%)	$1.78M (.94%)	.94%
Dollars and percent devoted to burdened national advertising	$6.83M (4.52%)	$14.27M (8.54%)	$14.59 (7.82%)	6.70%
Dollars and percent devoted to field level support cost	$33.24M (22.01%)	$37.78M (22.61%)	$40.78M (21.85%)	23.49%
Dollars and percent devoted to on-board recruiters @ $32,000 per man-year	$109.472M (72.5%)	$113.50M (67.94%)	$129.50M (69.38%)	68.87%

Table 10: Comparison of Resource Utilization with Percentages by Year
(with Recruiters considered as Exogenous; same as situation in Models 2B and 2C)

	FY84	FY85	FY86	Estimated Efficient Levels From Model 2B	Estimated Efficient Levels From Model 2C
Total expenditures (exclusive of recruiter and Headquarters costs)	$41.52	$53.56	$57.15		
% Burdened Navy Advertising	$6.83M (16.5%)	$14.27M (26.6%)	$14.593M (25.5%)	20.8%	50.8%
% Local Advertising	$1.447M (3.5%)	$1.51M (2.82%)	$1.779 (3.11%)	3.1%	3.1%
% Field Level	33.24M (80.0%)	$37.78M (70.54%)	$40.78M (71.36%)	76.1%	46.1%

Consider now some of the key substitution insights from the cost allocation model 2A which is thought by the author to be of the most relevance since recruiters are included explicitly. (To exclude recruiters, in terms of analysis of substitution possibilities between various types of contracts would be to exclude the single most important factor in recruiting.) We shall also impose the necessary conditions for efficiency since we are interested in the minimum costs needed. Hence Model 2A's scenario is the focus:

i) The coefficient of the logarithm of (number of contracts of type A (1 - IIIA,HSDG's)), denoted a_1, = .604.

Also the coefficient of the above variable squared, denoted c_1, was insignificant and hence is taken to be 0. Hence the elasticity of A type contracts on the efficient recruiting cost, i.e. $\frac{d(\ln K)}{d(\ln y_1)} = a_1 + 2c_1(\ln y)_1$, is estimated to be .604. Hence every 1% increase in A type contracts is predicted to increase total efficient recruiting costs (exclusive of headquarter's cost) by .604%. The fact that the elasticity is not larger than 1 is because not all of recruiting cost is devoted to A type contracts.

ii) The coefficient of the log(number of contracts of type C_u), denoted a_3 = -1.1797 and the coefficient of the above variable squared, c_3, = .1158 and significant. Hence the elasticity of C_u contracts (III B, HSDG's) on the efficient recruiting cost is $-1.1797 + 2(.1158) \ln y_3$. Evaluating the elasticity at the actual mean (for FY86) of 292.68 C_u cell contracts per region per month, yields the elasticity of C_u cell contracts on total efficient recruiting of .136. Hence the substitution rate of C_u cell contracts to A cell contracts is 4.44. That is, 4.44 C_u cell contracts can be traded off for 1 A cell contract, with no change in recruiting cost.

iii) The coefficients a_2 and c_2, related to B cell contracts (1-IIIA,NHSDG') are insignificant, suggesting they have no impact on recruiting costs, i.e. non HSDG's are not supply limited, but rather are demand limited.

iv) The coefficient a_4 for C_ℓ contracts (HSDG, 4A) is -.12 and the coefficient c_4 for C_ℓ contracts is .01368, being significant.

Hence the elasticity of C_ℓ contracts on minimum recruiting costs is $-.12 + 2(.01368)\ln(y_4)$.

Evaluating the elasticity at the mean for FY86, we obtain an elasticity of .012.

Hence this implies that the recruiting effort required for 11.33 C_ℓ cell contracts is equivalent to that for one C_u cell contract.

v) The coefficient a_5 for D cell contracts (3L, NHSD) is .002 and very significant. Since no c_5 variable was included in the regression due to the small number of D contracts, the elasticity for D cell contracts is estimated at .002. This implies 6 D cell contracts could be exchanged for 1 C_ℓ cell contract with no change in recruiting resources.

vi) Hence the sum of the elasticities (evaluated at the mean for FY86) for all types of contracts is .754, suggesting that a 1% increase in all types of contracts across the board would be accompanied by a .75% increase in recruiting costs, holding headquarters cost, unemployment rate, local DoD advertising expenditures, etc. fixed. This exhibits a small increasing return to scale at this level, suggesting that expenditures for recruiters, advertising, field support enjoy some small economies of scale, at least for the levels expended in FY86. We also observe that about 80% of the increase in cost is due to the A cell component. Hence to summarize the substitution possibilities among the HSDG holders we present the following matrix:

	A cell	C_u cell	C_ℓ cell
A cell	1	4.44	50.33
C_u cell	.225	1	11.33
C_ℓ cell	.0199	.088	1

i.e. the total of all recruiting cost at the margin to obtain 1 A cell contract (i.e., HSDG, 1-IIIA's) could be used to obtain 4.44 C_u cells (III-B's) or 50.33 C_ℓ cell (i.e. IV-A's); the effort to obtain 1 C_u cell contract can obtain .225 A cells contracts or 11.33 C_ℓ cell contracts; the effort to get 1 C_ℓ cell can be used to obtain roughly .088 C_u cell contracts, or .02 A cell contracts.

vii) Impact of Relief from Direct Ship Pressure on Recruiting Cost

As the percents of past months' accession goals that are satisfied from DEP increases, the recruiting cost for upcoming months is decreased, as expected. This is due to the fact that relief from direct ship pressures provides recruiters the luxury of prospecting in the higher quality market. As a consequence they don't have to rely on the "direct ships" to meet their short term quotas. The recruiting effort is "smoothed" and more orderly. As a concrete example, the model implies if direct ship pressure is reduced in a given month, the cost of recruiting 3 months down stream is reduced, the elasticity being -.097 (and statistically significant at the 4.5% level). Hence for FY86, the average percent of a month's accession goal coming out of DEP was 91.6%. If this was increased by an average of 1% to 92.5%, this implies that recruiting cost (exclusive of headquarters support cost) in FY86 (at about $187M) could be reduced by about $180K.

viii) Impact of Exogenous Variables:

a) Percent Black in male, 17-21 old population: As this percent increases, recruiting cost increases, as expected, the elasticity being .031.

b) Unemployment: As unemployment increases, the recruiting cost decreases, as expected, the elasticity being -.048. This is consistent with the fact that higher unemployment aids recruiting.

c) Ratio of Military/Civilian Pay: As ratio of military to first year civilian pay increases, recruiting costs go down, as expected, the elasticity being -.068. This coefficient is however statistically insignificant, perhaps due to small variations in the measure or problems in its measurement.

d) Joint DOD Advertising Expenditures: As Joint advertising expenditures increase, Navy recruiting costs decrease as expected (the elasticity is -.0002 but it is insignificant).

e) NRC Headquarter's Expenditures: As the model was run at the regional level and since much of the Headquarter's expenditures is difficult to reduce (e.g., civilian budgets), we excluded NRC's Headquarters expense from the dependent variable (recruiting cost) but included it as an exogenous variable. Its impact was as expected, i.e., as NRC Headquarters expense increased, other recruiting costs can decrease, the elasticity being -.002 (significant at the 17% level).

5.0 MINIMAL SIZES OF DEP OF A AND C_u TYPE

5.1 Criterion Utilized

One of the key foci of this research effort has been to gain some quantitative insights as to the optimal size and mix of DEP. We observe from Table 5 of Section 2 that in FY86 the total male DEP average was 26,303 for a total DEP

ESTIMATED RECRUITING COST ELASTICITIES

A CELL CONTRACTS	.604
A CELL DEP	-.205
C_U CELL CONTRACTS	.136
C_U CELL DEP	-.08
B CELL CONTRACTS	0
C_ℓ CELL CONTRACTS	.012
RELIEF FROM DIRECT SHIP PRESSURE	-.097
PERCENT BLACK	.031
LOCAL UNEMPLOYMENT RATE	-.048
RATIO OF MILITARY/CIVILIAN PAY	-.068
JOINT DoD ADVERTISING EXPENDITURES	-.0002*
NRC HEADQUARTER EXPENDITURES	-.002

*NOT SIGNIFICANT AT 5% LEVEL

Table 11: Comparisons of DEP by Fiscal Year

	FY84	FY85	FY86
Average size of DEP per recruiter	12.21	.939	8.098
Average DEP size as a percent of total contracts obtained	54.4%	42.6%	33.2%
Average DEP size of type A per recruiter	6.96	4.64	3.52
Average DEP size of type C_u per recruiter	2.46	2.27	1.96
Average ratio of A cell DEPers to C_u cell DEPers	2.82	2.03	1.79

size per recruiter of 8.098. This was down from FY84 and FY85 levels of respectively 12.21 and 9.939. Hence in reality DEP size has been falling (see Table 11). The total average DEP of type A per recruiter was 3.52 and for the C_u cell, it was 1.96 for a ratio of 1.79 A cell DEPers to each C_u cell DEPer. The key questions being raised are "What should these levels be?". The first issue to be addressed is, "What is the criterion for best?". We have taken the viewpoint in this exploratory analysis that the DEP size and mix should be chosen to minimize the need for recruiting expenditures (including cost of recruiters), i.e., we wish to select the DEP size and mix that will minimize the total of Navy national advertising, Navy local advertising, field level support cost and Navy recruiters. Using $32,000 per man-year for a recruiter's salary and benefits, total recruiting expenditures (excluding headquarter's cost) was about $187M in FY86 with about two-thirds of it being expended for recruiter's salaries and benefits (see Table 9 of Section 4.2).

We observe at this point that there are increasing DEP indefinitely is not practical. Increasing DEP beyond a certain stage can lead to inefficiencies and drain time from recruiter's other activities. Indeed, the Air Force a few years ago made a conscious decision to reduce DEP since they felt it was becoming unmanageable. Then DEP levels per recruiter were of the order of 42. However, the Navy experience has had a high DEP ratio of about 11.54 so that the Navy hasn't had to worry about DEP being too high.

5.2 Basic Approach

The econometric Translog model yielded a generic function of the efficient total recruiting cost needed to meet a given number and mix of contracts in a given recruiting environment, employing a given DEP policy. The DEP variables included the size of male DEP for each of A and C_u cells. Also quadratic and linear functions of these policy variables were included, as well as

interactions of these quantities with the number of recruiters present. These functions can be used to compute an elasticity for the size of DEP of a given type on total recruiting cost. Then one can ask what the DEP sizes need to be for this impact to be beneficial.

5.3 Threshold DEP Size for Type A Recruits

Consider first the estimated elasticity on efficient total recruiting costs of changes in DEP size of type A.

The elasticity for DEP of type A on total efficient recruiting cost is by definition:

$$\frac{d(\ln(\text{efficient recruiting costs}))}{d(\ln(\text{DEP type A})} \qquad (7)$$

From the run 2A, we have, focusing only on the statistically significant variables (at about the 10% level of significance):

$$\ln(\text{efficient recruiting costs}) = .92 \ln(\text{size of DEP of type A, 2 months lagged}) - .29[\ln(\text{size of DEP of type A, 2 months lagged})]^2 + .5729 \ln(\#\text{ of recruiters}) \ln(\text{size of DEP of type A, 2 months lagged}) + \text{constant (a function of variables other than dep size of type A).} \qquad (8)$$

Hence the elasticity of DEP of type A on efficient recruiting costs, from (7) and (8), is .92 -.58 ln(size of DEP of A type) + .5729 ln(# of recruiters), or approximately:

$$.92 - .58 \ln\left(\frac{\text{DEP A}}{\text{rec}}\right) \qquad (9)$$

Note as expected, this is becoming more pronounced as the size of DEP of type A per recruiter increases (as long as DEP A per recruiter exceeds 1). Also the elasticity of DEP size of type A on recruiting cost is not constant but depends on the level of DEP of type A per recruiter. For

FY84, e.g., this works out to be -.205, i.e. a 1% increase in DEP of type A decreases total recruiting cost by .2%.

Denoting DEP^*_A as the optimal size of DEP of type A lagged 2 months, we have the minimum threshold levels for dep sizes of type A, i.e. the level of DEP of type A per recruiters where the elasticity first becomes negative, i.e. choose DEP^*_A so that

$$.92 - .58 \ln\left(\frac{DEP^*_A}{\text{recruiter}}\right) \leq 0 \qquad (10)$$

or $\dfrac{DEP^*_A}{\text{recruiter}} \geq 4.8836.$

Since the average DEP of type A in FY86 was 3.52, this minimal threshold condition represents an increase of about 40% over the FY86 level. Put another way, in FY86, the average DEP size of type A was 14,268 with an average recruiter size of 4,047 recruiters. Given the minimal DEP_A size per recruiter (from (10)), the minimal size of DEP of type A would have been 19,764 DEPers, an increase of about 5500 or about 40%.

5.4 Threshold DEP Size for Type C_u Recruits

Performing the same analysis for DEPers of type C_u (i.e. HSDG, IIIB's), the equation from the regression is:

ln (efficient recruiting costs) =

- .829 ln(size of DEPers of type C_u, 2 months lagged)

+ .3115(ln(size of DEPers of type C_u, 2 months lagged))^2

- .571 ln (recruiters) ln (size of DEPers of type C_u, 2 months lagged)

Hence the elasticity of DEP of type C_u on the efficient recruiting costs is $-.829 + .623 \ln(\text{size of DEP of type } C_u) - .571 \ln(\text{recruiters})$.

For FY86, e.g., this works out to be -.08, i.e. a 1% increase in size of DEP of C_u cell decreases total recruiting cost by .08%. We observe this elasticity

also is not constant, and depends on the level of DEP of type C_u.

Next focus on the minimal size of DEP of type C_u. Denoting DEP^*_{CU} as the optimal size of DEP of type C_u, we obtain as the minimal threshold for C_u type DEP,

$$-.829 + .623 \ln(DEP\ C^*_u) - .571 \ln(\text{recruiters}) \leq 0 \tag{11}$$

or

$$\frac{3.783}{rec^{.083}} \leq \frac{DEP\ C^*_u}{\text{recruiter}} \tag{12}$$

For FY86, the average number of recruiters per area per month was 674.5. Hence for FY86, the minimal DEP size of type C_u per recruiter would have been

$$\frac{3.783}{(674.5)^{.053}} = \frac{3.783}{1.717} = 2.20. \tag{13}$$

This represents about 10% increase over the FY86 level. Put another way, in FY86, the average DEP size of type C_u was 7,956, with an average number of recruiters of 4,047. From the above, the minimal number should have been 8,903, an increase of about 1,000. Combining the type A and type C_u together, we suggest a minimal increase of about 6500 DEPers in these 2 categories, an overall increase of about 29% in these 2 categories that constituted about 85% of all DEP. We also observe these recommended threshold levels are considerably higher than the actual FY86 levels, are quite close to the levels observed in FY85, and were exceeded by the actual levels in FY84.

Table 12: MINIMAL THRESHOLDS FOR DEP SIZES OF TYPE A AND C_u CELL CONTRACTS

	A cell DEP	C_u cell DEP	Total of A cell & C_u cell
1) Minimal DEP/recruiter	4.88	2.2 (in FY86)	7.08
2) Actual A DEP/recruiter in			
FY86	3.52	1.96	5.48
FY85	4.64	2.27	6.91
FY84	6.96	2.46	9.42
3) Actual Average Size DEP in FY86	14,268	7,956	22,224
4) Minimal Size DEP in FY86	19,764 (increase of 40%)	8,903 (increase of 11%)	28,667 (increase of 29%)

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Each of the branches of the Armed Services allows a recruit to delay his shipping date for up to a year from the time he signs a contract. The Delayed Entry pool consists of those recruits who choose to delay more than a month. The key issues addressed in this research have to do with: the size and the makeup of dep (i.e. the quality mix) on contract production of various types; the "compactness" of dep or how dep is distributed over time (i.e. the schedule which converts dep into accessions); and how dep resources compare to the impacts of other resources. The effort is also concerned with how to tradeoff advertising, recruiters and support cost in order to meet a given mix and level of contracts in a given recruiting environment at minimum total cost. Hence it bears on the important issue as to the cost to the country of varying quality. One of the other key conclusions is that the overall dep levels were too low in FY86 and should be increased at least 29% in order to gain the most productivity from dep.

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